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Distribution analysis of airborne nicotine concentrations in hospitality facilities

Matthias K. Schorp[a,*], Donald E. Leyden[b]

[a]Worldwide Scientific Affairs, Philip Morris Products SA, CH-2000 Neuchâtel, Switzerland
[b]P.O. Box 70, Deltaville, VA 23043, USA

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Abstract

A number of publications report statistical summaries for environmental tobacco smoke (ETS) concentrations. Despite compelling evidence for the data not being normally distributed, these publications typically report the arithmetic mean and standard deviation of the data, thereby losing important information related to the distribution of values contained in the original data. We were interested in the frequency distributions of reported nicotine concentrations in hospitality environments and subjected available data to distribution analyses. The distribution of experimental indoor airborne nicotine concentration data taken from hospitality facilities worldwide was fit to lognormal, Weibull, exponential, Pearson (Type V), logistic, and loglogistic distribution models. Comparison of goodness of fit (GOF) parameters and indications from the literature verified the selection of a lognormal distribution as the overall best model. When individual data were not reported in the literature, statistical summaries of results were used to model sets of lognormally distributed data that are intended to mimic the original data distribution. Grouping the data into various categories led to 31 frequency distributions that were further interpreted. The median values in nonsmoking environments are about half of the median values in smoking sections. When different continents are compared, Asian, European, and North American median values in restaurants are about a factor of three below levels encountered in other hospitality facilities. On a comparison of nicotine concentrations in North American smoking sections and nonsmoking sections, median values are about one-third of the European levels. The results obtained may be used to address issues related to exposure to ETS in the hospitality sector.
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Keywords: Environmental tobacco smoke; Indoor environment; Exposure; Modeling

1. Introduction

Interest in quantifying exposure to environmental tobacco smoke (ETS) has led to a substantial number of publications on concentrations of ETS-related constituents in indoor environments. Among those contaminants measured are ETS-specific compounds, such as nicotine, 3-ethenylpyridine, and solanesol, and those that are derived from both ETS and other sources, such as ultraviolet-absorbing particulate matter (UVPM), fluorescing particulate matter (FPM), PM_{10}, TVOC, etc. A number of reviews have summarized the results of ETS-related measurements (e.g., U.S. EPA, 1992; Guerin et al., 1992; Jenkins et al., 2000; CalEPA, 1997; Dimich-Ward and Brauer, 2001), but to our knowledge data taken in hospitality facilities have not been the subject of statistical or distribution analyses. Such analyses are useful in determining the value above and below which a given proportion of a distribution falls when data are not normally distributed and in supplementing the information contained in statistical parameters such as the arithmetic mean and standard deviation.

Our objective was to examine whether distribution frequency plots can be generated from published data and, if successful, to plot the frequency distributions for a variety of indoor environments. Because of its frequent use as an ETS marker, we selected reported nicotine concentrations in hospitality environments for this work. The majority of the published studies do not report individual data points of nicotine concentration. Instead, they report various statistics such as number of samples, arithmetic mean, geometric mean, median, standard deviation, range, lowest value, highest value, and various percentile values. There is

* Corresponding author. Tel.: +41-32-888-5633; fax: +41-32-888-5776.
E-mail address: schorp.matthias@pmintl.ch (M.K. Schorp).

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